Multi-purpose Time Analyzer and Monitor for Deep Space Network Time Synchronization

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The NASA Deep Space Network (DSN) is an international network of antennas that supports interplanetary spacecraft missions and radio and radar astronomy observations. The DSN consists of three tracking stations at Goldstone, in California's Mojave Desert; near Madrid, Spain; and near Canberra, Australia. Independent master clocks at each station are synchronized to UTC using traditional GPS common view techniques. Each station contains up to 10 different antennas separated by up to 30 kilometers. Within each station, time code translators (TCT's) are used to convert distributed frequency and serial time code signals generated from the online frequency standard and master clock into a stable and synchronous 1 pps reference signal for approximately 120 separate users. These TCT's also compensate for distribution related timing delays.

We report the development of a multi-purpose, automated, and continuously operating time analyzer to measure and monitor distributed 1 pps signals. The instrument consists of a PC to control a VXI based time interval counter and multiplexer with a Labview based user interface and LINUX OS. The instrument performs three major functions needed for operation of the DSN Frequency and Timing Subsystem.

1) Performance tests and monitor of timing offsets and jitter of 1 pps timing outputs of 120 TCT's relative to the station master clock. Time offset data from each TCT is summarized in histogram form. Additional test channels to monitor 1 pps from any other source (e.g. the GPS time sync receivers) against the master clock are also provided

2) Captures any anomalies and alerts station operators in event of performance or operational failure. Archives timing configuration, station performance, and status.

3) Provides monitor of frequency offsets and long term stability of backup frequency standards with respect to the online frequency standard (which drives the master clock). Time and frequency offset data between online and backup frequency standards are analyzed over a twenty-four hour period and displayed numerically.

The user interface is designed to provide a high level summary of the entire timing system performance and to alert station operations in the event of an anomaly. Raw data is fully archived and network accessible if detailed analysis is warranted.

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